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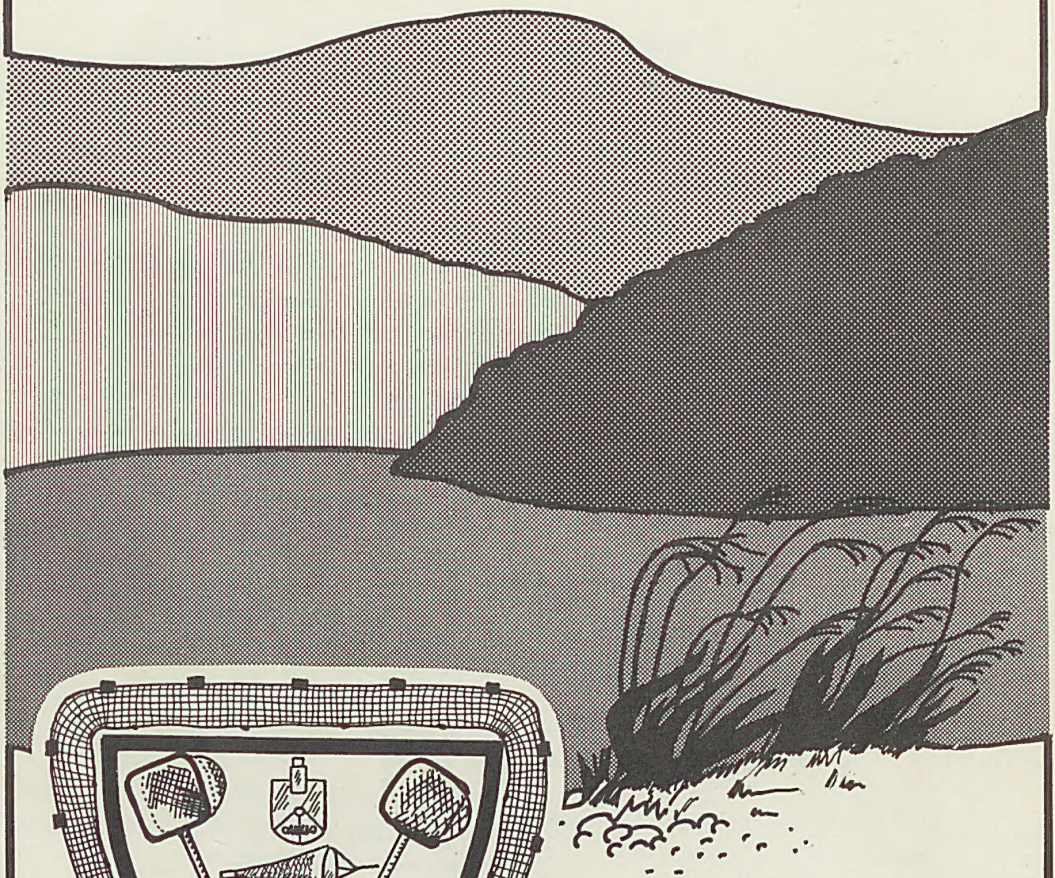

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EDITORIAL

The Fate of Lake Pedder and its Biota

Those few of us who attended the Conservation Symposium at the ANZAAS Conference recently held in Hobart were disturbed to learn of a threat to the continued existence of Lake Pedder as we now know it. The news came not from the formal proceedings of this symposium, but was contained in a brochure distributed by the (Tasmanian) South-West Committee. This was prepared following a statement to the Press by Mr. Reece, the Premier of Tasmania, on June 21st this year, outlining a proposal by the Hydro-Electric Commission to "modify" the Lake Pedder National Park. The full details of the proposal are at present unknown, and, indeed, it is for the purpose of obtaining detailed knowledge of water levels and the nature of the terrain that the H. E. C. is now driving a road toward the Gordon River lying to the north of Lake Pedder. Nevertheless, in essence the proposal involves the construction of a dam across the Serpentine River which receives the outflow from Lake Pedder and which joins the Gordon River. The probable affect of this damming would be to flood the present lake out of existence and create a much larger artificial reservoir in its place. Such is the nature of the proposed modification of a region which was proclaimed a National Park in 1955. It is ironical that the purpose of the first road to give easy access to the Lake Pedder region should be to investigate the feasibility of a project that would bring about its destruction.

Those in favour of the scheme may argue that increasing the size of the lake would add to the beauty of the area. Apart from the fact that these people may not be vitally concerned with the appearance of the landscape, such an argument can be refuted on aesthetic grounds, and disregards the adverse affects of artificial water-level fluctuations on littoral biotic communities. The adverse affects of fluctuating or astatic water levels on the fauna of artificial reservoirs has been shown by a number of workers. Hynes (1961) investigated a lake in North Wales, the littoral fauna of which was rich and varied in 1951-1952. In 1955 a barrage was installed at the outflow for the purpose of flood control. As a result, fluctuations in water-level, which previously had not exceeded about 2 m, were increased to 5 m. Examination in 1957 and 1959 revealed that, although there had been an increase in the population density of oligochaetes, numerous species had almost or completely disappeared. During the discussion of this paper,

Worthington drew attention to the great influence of the rapid fluctuation of lake levels on the food supply available for trout. He cited the example of Lake Vyrnwy, also in Wales, where littoral fauna was so scarce because of fluctuating levels that trout fed predominantly on zooplankton and grew very slowly. The results of a biological survey of Lake Roxburgh, a hydro-electric dam in the South Island of New Zealand, are given by Winter (1964). He stated "In Windermere, Moon (1935) found that the more active littoral organisms could keep pace with a rise in water level of 0.63 cm/hr., but were left behind by a rise of 1.25 cm/hr. In L. Roxburgh the water rises at 5 cm/hr. and drops at 3 cm/hr. so that the littoral fauna would find it impossible to keep pace with the rise and fall of the water level. This water fluctuation undoubtedly reduces the littoral fauna considerably.". Later Winter stated "In the region of water fluctuations the mud bank has been sorted and compacted by the lapping water as it rises and falls, making the bottom an unfavourable environment for the (normal) fauna. Below this the silt rapidly becomes much softer so favouring higher animal numbers particularly of oligochaetes. This shows the effect of the water fluctuation on the littoral zone.". Lake Roxburgh is perhaps an extreme example because of its comparatively small volume and high rate of water renewal.

Turning now to Tasmania itself, it is probably only fortuitous that Paranaspides lacustris has survived the fluctuations in the level of the Great Lake brought about by hydro-electric developments (vide Williams 1965). This is probably equivalent to saying that it is only good fortune, not good management, that P. lacustris is not already extinct, since it is known only from three inter-connected localities, Great Lake, Shannon Lagoon and Penstock Lagoon. The level of the Great Lake was artificially raised by 7.5 metres in 1922. In 1929 Manton (1929) found that P. lacustris was almost extinct and had been for the preceeding few years. It would seem, as maintained by Manton, that it was this rise in water-level and the consequent destruction of suitable habitats, rather than the introduction of trout, which brought about this near extinction. By 1942 sufficient regeneration of habitats had occurred for P. lacustris to again be abundant and in February 1963 the species still existed in considerable numbers. However, there is a proposal to further increase the level of the Great Lake by 9.3 metre in 1968 or thereabouts, and this could quite possibly bring about the extinction of P. lacustris in the only natural locality at which it is known to occur.

In 1963 Williams (1965) was unable to find Anaspides tasmaniae in any lake on the central plateau where it now appears to be restricted to small streams and pools. It is quite possible that A. tasmaniae formerly occurred in the littoral region of lakes in this area, but has now been eliminated from this habitat by the predation of introduced fish. Nicholls (1947) recorded A. tasmaniae from Lake Pedder. Furthermore there is a collection of A. tasmaniae in the Tasmanian Museum which, according to the label, was obtained from Lake Pedder in 1939. It is quite possible, therefore, that a population of A. tasmaniae still persists there. If so, Lake Pedder would be the only sizeable lake in Tasmania that still contains A. tasmaniae. (There are unpublished reports that A. tasmaniae occurs in several relatively small lakes in the Arthur Range and in the vicinity of Federation Peak, and in August this year I collected a solitary specimen from Lake Osborne in The Hartz Mountains). There is good reason to suppose that such a population would be largely restricted to the littoral region, and would fare poorly with a sudden substantial rise in water-level such as would occur if the Serpentine River were dammed.

It may be assumed that damming would have an adverse affect not only on the littoral fauna of Lake Pedder, but also, and perhaps less importantly, on the flora and fauna of the Serpentine River downstream from the dam. This was found to be the case with a Swedish river investigated by Müller (1962).

Apart from the biological affects of oscillations in water-level, there is the aesthetic side to be considered. As the South West Committee has pointed out in their submission to the Tasmanian Government, the plains surrounding Lake Pedder could not be flooded to any great depth, and extensive areas of unsightly mudflats and dead trees would appear during storage draw-off. This very situation can be observed on the western shores of Lake King William during late summer. By comparison, Lake Pedder as it now exists possesses a beautiful beach consisting of almost pure quartzite sand and stretching for nearly two miles along one side.

Practically nothing is known concerning the limnology of Lake Pedder, and certainly less is known about it than any other freshwater lake of comparable size in Australia. Bearing this in mind, and not overlooking the possibility that the worst might happen, time may well be running out for us to rectify this deficiency. It is partly because of this realization that a party of five, including four A.S.L. members,

is planning a brief trip to Lake Pedder early next year. This can only be in the nature of a very preliminary investigation and much will remain to be done.

It is unrealistic to suppose that the views of limnologists, or limnological considerations, will count for much in the Tasmanian Government's decision as to the fate of Lake Pedder. In fact, even the opinion of an expert committee set up by a government to report on such matters may go unheeded, as illustrated by the example of Lake Manapouri in New Zealand. This lake, which is located approximately at latitude 45°S (cf. Lake Pedder 43°S), is noted for its great depth. With a maximum depth of 445 m Lake Manapouri is easily the deepest lake in the Australasian region, the 15th deepest in the world, and the only Australasian lake to appear in Hutchinson's (1957) table setting out the morphometric parameters and mode of origin of those lakes known to be deeper than 400 metre. From the faunal viewpoint it would certainly be less interesting than Lake Pedder, although from the standpoint of physical limnology the reverse is perhaps true. Following the proposal to raise the level of Lake Manapouri for hydro-electric purposes a committee reported adversely on the proposal. The government was more than a little disturbed - but undeterred, and so today the mighty project is in full swing.

Whilst it is unrealistic to suppose that the limnologists viewpoint will be given a large amount of consideration, it is a completely defeatist attitude not to state it forcefully. If a sufficient number of people of prominence in the community raise their voices, if a newspaper will champion the cause, and if public opinion becomes sufficiently aroused, conservation issues may be won in favour of posterity. This was well illustrated by a recent Queensland example. Here the noted poetess Judith McKinney (nee Wright), a Brisbane newspaper, a prominent geologist, and others stirred public opinion sufficiently to save the day, temporarily at least, for a considerable stretch of wallum country and its associated lakes. In this case mining operations in the Noosa region would undoubtedly have resulted in a temporary profit being shown in the balance sheet of the mining company, but they would almost certainly have resulted in a permanent bankruptcy in the aesthetics of the landscape.

Hutchinson (1963) has this to say, "Although large lakes are of great importance in transport and many natural and artificial lakes are essential sources of hydroelectric power and water, all lakes can play

an increasing role in providing an aesthetically satisfactory background to human life, and it is by no means unlikely that, great as the immediate practical value of an increasing number of lakes may be, the less obvious role may prove to be the more important. This aesthetic aspect of limnology may well prove to be inversely associated with the increasingly significant problems of mental health that develop in highly industrialized and urban societies.". Perhaps if a larger proportion of the Australian population feasted their eyes more frequently on spectacles such as that now provided by Lake Pedder our hospitals would be a little less crowded. Perhaps the road headed for the Gordon River could be put to this more constructive purpose.

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SCIENTIFIC CONTRIBUTIONS

Endemism in the Tasmanian Freshwater Fauna - a Comment on an Article by Dr. E. R. Guiler in "Atlas of Tasmania"

by

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A feature of the recent ANZAAS Conference held in Hobart, Tasmania (16th-20th August, 1965), was the publication of "Atlas of Tasmania", edited by J. L. Davies and published by the Lands and Surveys Department, Hobart. This was issued as a handbook for delegates to the Conference, and is now on sale to the public. The Atlas is a most worthy and handsome publication, and the editor, contributors and publishers are all to be congratulated.

The Atlas consists largely of a series of commentaries written by Tasmanian authorities on a diversity of topics. Students of natural science, geography, economics, education and sociology will all find something of interest. Special features include a well-chosen series of oblique aerial photographs (including Lakes St. Clair and Dulverton) which are accompanied by informative captions, and an excellent series of topographical maps. Whilst we are not competent to judge the accuracy of most contributions, the coverage seems to be quite adequate in most cases and in some instances excellent. However the chapter by Guiler (1965) on the animals of Tasmania contains some misleading and inaccurate statements, and it is the purpose of the present note to draw attention to one of the most important of these. Particular reference will be made to freshwater animals.

In Guiler's first paragraph the statement is made that "Tasmania, although once connected to the Australian continent, has very few endemics both in its vertebrate and invertebrate fauna". This is certainly not true for those groups in which we are interested. In fact, if we were asked to nominate the most interesting aspect of the Tasmanian freshwater fauna we would probably cite its endemism.

We would maintain that Tasmania has a large number of endemics despite the fact that it was once connected to the Australian continent.

Until recently (1963), Tasmania was the only place in the world where "typical" syncarids (Crustacea:Syncarida:Anaspidacea) were known to be extant; Anaspides tasmaniae (Thomson) and Paranaspides lacustris Smith are surely well-known and of great interest to zoologists throughout the world. Two other syncarids, Micraspides calmani Nicholls and Anaspides spinulae Williams, are also endemic to Tasmania. Endemism is by no means restricted to the Syncarida, and we supply the following list for the quite restricted number of groups in which we are interested:

CLASS CRUSTACEA

SUBCLASS COPEPODA

(1) Boeckella rubra Smith

SUBCLASS MALACOSTRACA

Order Anaspidacea

(2) Anaspides tasmaniae (Thomson)
(3) Paranaspides lacustris Smith
(4) Micraspides calmani Nicholls
(5) Anaspides spinulae Williams

Order Isopoda

Tribe Phreatoicidea

(6) Uramphisopus pearsoni Nicholls
(7) Hypsimetopus intrusor Sayce
(8) Phreatoicoides longicollis Nicholls
(9) Mesacanthotelson tasmaniae (Thomson)
(10) M. setosus Nicholls
(11) M. dicipieus Nicholls
(12) M. fallax Nicholls
(13) Onchotelson brevicaudatus (Smith)
(14) O. spatulatus Nicholls
(15) Paraphreatoicus relictus Nicholls
(16) Colubotelson thomsoni Nicholls
(17) C. evansi Nicholls
(18) C. campestris Nicholls
(19) C. huonesis Nicholls
(21) C. chiltoni Sheppard
(22) C. fontinalis Nicholls
(23) C. tattersalli Sheppard

(20) C. gesmithi Nicholls (24) C. intermedius Nicholls
(25) C. setiferus Nicholls
(26) Metaphreatoicus magistri Nicholls (27) M. affinis Nicholls

Tribe Asellota

(28) Pseudasellus nichollsi Chappuis

Order Amphipoda

(29) Neoniphargus yuli Smith
(30) N. exiguus Smith (33) N. alpinus Smith
(31) N. tasmanicus Smith (34) N. niger Smith
(32) N. wellingtoni Smith (35) N. montanus Thomson
(36) Gammarus mortoni (Thomson)
(37) G. ripensis Smith (38) G. antipodeus Smith

Order Decapoda

(39) Paratya tasmaniensis Riek
(40) Astacopsis franklinii (Gray)
(41) A. gouldi Clark (42) A. tricornis Clark
(43) Engaeus ignotus Clark
(44) E. cunicularius Erichson (45) E. leptorhynchus Clark
(46) Parastacoides tasmanicus (Erichson)
(47) P. inermis Clark (49) P. setosimerus Riek
(48) P. insignis Clark (50) P. leptomerus Riek

In addition to the existence of absolute endemism, Tasmania is the main region of occurrence of some taxa. Thus the calanoid copepod Calamoecia gibbosa, which was originally described by Brehm from Lake Dulverton, is now known from six localities in Tasmania (including Flinders Is.), but the only mainland records are from three lakes in or near Mt. Gambier. Guiler mentions that a "number of species of Phreatoicids (sic)" (Phreatoicidea) occur in Tasmania and states that it is "a group which is well-known and well represented here". In fact, they are more common and abundant in Tasmania than anywhere else in the world. It is true that the Phreatoicidea also occur throughout the southern half of the mainland, but Nicholls (1946), summarizing his earlier comprehensive work on the Tasmanian phreatoicids, notes that in the family Phreatoicidae "more than half are Tasmanian". Within the Phreatoicidae, "the great majority are included in the sub-family Paraphreatoicinae, almost exclusively Tasmanian, occuring widely scattered over the island". "The few mainland forms which exist today are known only from isolated mountain tops in the Victorian Alps". A third Phreatoicid sub-family,

the Mesacanthotelsoninae, with one specific exception (an Australian species), appears to be confined to the Great Lake and Arthurs Lakes. The high endemism and species numbers of the Phreatoicidae is paralleled also by the order Amphipoda.

Guiler states that the freshwater fauna has been little studied. In comparison with overseas countries this is perhaps true, but it would be more appropriate to change the emphasis of this statement and point out that the Tasmanian freshwater fauna is at least as well and probably better known than that of any mainland state. It was pointed out by Bayly (1964, p. 212) that, "a considerable number of freshwater collections from Tasmania have now been examined for copepods; probably more per unit area than anywhere else in Australia". The late Professor G. E. Nicholls searched Tasmania far and wide for phreatoicids and syncarids. Williams (1965, p. 108) mentions that 99 Tasmanian localities were searched for Anaspides tasmaniae during January and February 1963. In the first number of this Newsletter it was stated that Dr. A. G. Nicholls carried out on Tasmanian trout "one of the most exhaustive studies of its kind ever to appear in print anywhere". It might also be mentioned that prominent overseas zoologists have visited Tasmania to study the freshwater fauna; Smith early this century, Manton in 1929, and the Deeveys as recently as this year, might be cited as examples. In general, it might be said that the Tasmanian freshwater fauna has attracted more attention than that anywhere on the mainland.

Guiler's conclusion that the Tasmanian fauna is not as rich in species as continental Australia is again untrue of the groups in which we are interested - at least it is on an areal basis. On the contrary, it is remarkably rich in species in view of its size (a wide range of lake altitudes occur within a relatively small area). Brehm, who has devoted the whole of his long life to the study of freshwater fauna on a world-wide basis, made (Brehm 1953, p. 61) the following comparison: "The abundance of calanoids on the island is surprising. This abundance can only be conceived if the calanoid fauna of Tasmania is compared with that of a similar equally large territory on another continent. Bohemia in Europe would be about the same size as Tasmania. Now whereas Bohemia (apart from the sporadic and transient occurrence of Heterocope saliens) is inhabited by only a single genus of calanoids - Diaptomus - which is represented by two species, castor and vulgaris, Tasmania exhibits three genera with about a dozen species!" Similar comparisons may be made within

other groups. For example, considering the Isopoda, there are only three truly freshwater species in Great Britain (Hynes, Macan and Williams 1960) as compared with 23 endemic species plus several others, in Tasmania.

Although outside our field of limnology, we are surprised by Guiler's suggestion that the invasion of forests by possums is dependent on the existence of roads and logging tracks. One of us (I. A. E. B.) is familiar with the fact that Trichosurus vulpecula, an arboreal animal, spread rapidly throughout New Zealand after its unfortunate introduction there. This spread certainly did not require the assistance of roads and today large populations exist in remote areas.

In conclusion we would like to comment that it seems a great pity that such a golden opportunity to publicise the endemism, abundance and uniqueness of the Tasmanian freshwater fauna should have been missed. This is especially so in view of the fact that Guiler's article will be far more widely read than this one.

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The Distinctiveness of Australia's Inland Aquatic Fauna

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In a short introductory section to a chapter in the forthcoming book on Australian limnology edited by Alan Weatherley, I have made some brief comments concerning the great zoological interest of portions of the fauna of Australian inland waters. I believe, however, that the fauna deserves better than this, so to speak, and I have thought it worthwhile to expand my remarks into an article for the Newsletter. Whilst the interesting nature of all of the groups mentioned below has been recognised by authors writing specifically upon them, to my knowledge there has been no attempt, certainly recently, to provide an overall general assessment. Discussion is confined to groups within the Insecta and Crustacea (Arthropoda) and to the Bivalvia (Mollusca). Other groups are not discussed because in general either too little is known of them, or they display no distinctive features in Australia. The latter alternative should by no means be regarded as the usual case; many faunal groups of Australian inland waters still await critical biological investigation. Although this article is therefore rather restricted in scope, it should be borne in mind that insects and crustaceans are the most prominent invertebrates in inland waters, whilst molluscs are often important too.

Before dealing with the faunal groups in sequence, the point may also be made that although the geographical isolation of Australia has been a most significant factor in the present context, there are others which no doubt have been of at least some importance. One is the extreme aridity of most of Australia, and, in fact, Australia is the world's driest continent. Another is that unlike the situation in many other arid or semi-arid regions, it appears that all Australian inland saline waters are remarkably homogeneous in ionic composition, all being entirely dominated by sodium and chloride ions. Correlated with the aridity is the fact that many continental Australian lentic waters contain comparatively high amounts of total dissolved solids. Even in Victoria, the best-watered State of the mainland, only 49% of natural lakes greater than about $1 km^2$ size contain less than 3,000 mg/1. total dissolved solids. It is for this reason that I have been very careful to write "inland aquatic fauna" and not "freshwater fauna". Tasmania exhibits a rather different situation from that on

mainland Australia; in Tasmania, most waters are indeed quite fresh.

Within the Crustacea, the taxon of perhaps greatest interest is the division Syncarida. Until recently, typical representatives of this division - that is to say anaspidaceans as opposed to bathynellaceans - were known to be extant only in south-eastern Australia, from where five species have so far been described, Paranaspides lacustris Smith, Micraspides calmani Nicholls, Anaspides tasmaniae (Thomson) and A. spinulae Williams from Tasmania, and Koonunga cursor Sayce from Victoria. There also occur in Australia some underground species not yet fully described (Drummond, 1959).

Anaspidaceans are now known to be extant in South America (Noodt, 1963) as well as in Australia, and it is certainly true that related syncarids, those belonging to the order Bathynellacea, occur in such widely separated places as Britain, eastern Europe, Lake Baikal and Malaya. However, bathynellaceans are rather aberrant syncarids specialized for a subterranean mode of life, and it seems likely that south-eastern Australia represents the main area of survival for typical members of the division. The main interest of the Syncarida lies in the primitive structure of its members; the Syncarida undoubtedly diverged off from the main malacostracan stem earlier than either the Peracarida or Eucarida. Briefly, there is no carapace, little difference in form between thoracic and abdominal segments, and thoracic appendages display a primitive structure.

Another distinctive crustacean group occurring in Australian inland waters (as well as terrestrially) is the isopodan tribe Phreatoicidea. The vast majority of isopods have bodies which are dorso-ventrally flattened; in the Phreatoicidea, on the other hand, the body is either circular in cross-section or the animal is even laterally compressed (as in most Amphipoda). Phreatoicids are known from places other than Australia,-India, New Zealand, and South Africa, but, like the Anaspidacea, they have their main area of present distribution in south-eastern Australia. In Tasmania, for example, almost every creek, pond and lake contains phreatoicids, sometimes so abundantly as almost to exclude all other macroscopic invertebrates.

Three of the five extant families of the Decapoda Astacura occur in Australian inland waters. All three are restricted to the southern hemisphere, two, the Austroastacidae and the Euastacidae, to Australia entirely, the third, the Parastacidae, occurs also in Madagascar, New Zealand and South America. Within the Parastacidae however, there is a concentration of species within Australia, and,

according to the enumeration of Balss (1957), 28 of the 43 described parastacid species, and a majority of the known genera, are endemic to Australia.

With one exception, other decapods in Australian inland waters belong to genera occurring also outside Australia, often widely. The exception is Stygiocaris, an endemic genus of atyid prawns known so far from Western Australia only. Nevertheless, these genera by and large display an extremely high degree of specific endemicity. In the Potamonidae, all six species of the only genus present, Paratelphusa, are endemic, even though Paratelphusa is widely distributed in India, eastern Asia and the Indonesian Archipelago. In the Hymenosomatidae the single Australian species, Halicarcinus lacustris (Chilton), occurs only in a restricted area outside Australia (including Norfolk Island, Lord Howe Island, and New Zealand); peculiarly, this species is the only inland aquatic one of the sixteen or so within the genus. Concerning the Palaemonidae, it is known that the genus Palaemonetes has a single endemic species in Australian inland waters, (P. australis Dakin), whilst in the other genus, Macrobrachium, five of the seven species recorded from Australia are endemic. In the Atyidae, the single species of Atya is endemic, as likewise is the single species of Caridinides, all three species of Paratya, and both species of Parisia. Caridina is rather atypical; only three of the seven species known from Australia are endemic.

An extremely high degree of endemicity, both at the generic and specific level, is displayed also by the amphipods of Australian inland waters, and those few isopods other than the Phreatoicidea. Thus, in the Amphipoda it seems that all species are endemic (excluding perhaps the single one in the genus Paracalliope), although in the Gammaridae many of them have been placed in the widespread Palaearctic genera Gammarus and Niphargus. However, some doubt attaches to the exact correspondence of "Gammarus" and "Niphargus" in northern and southern hemispheres. With the exception of Paracalliope, Paramoera and Neoniphargus, other genera occurring in strictly inland waters in Australia are endemic. It is noteworthy that all species are recorded from the southern half of Australia only, although occurring there in both eastern and western sides; even along the comparatively wet eastern coast of Queensland, amphipods extend no further north than Brisbane. They appear also not to be present in the well-watered Kimberley region of Western Australia. Concerning the Isopoda (excluding phreatoicids), it may be noted that all three Australian genera are endemic; Pseudasellus

occurs in Tasmania, Heterias in Victoria, and Haloniscus in Western Australia, South Australia and Victoria. The last genus is interesting in that it is found in inland hyper-saline waters and belongs to the family Oniscidae which is almost an entirely terrestrial family. The occurrence of isopods in such situations is unique and unknown outside Australia.

All the crustacean groups mentioned above have no stage of their life-cycle that can withstand drying; all stages are entirely aquatic, and we might expect endemicity to be high in such groups. However, even in the case of inland water calanoid copepods whose possession of "resting eggs" has long been known, an extremely high degree of endemicity is found. With regard to the two principal genera, Calamoecia and Boeckella, it is noteworthy that the first is confined to Australia (twelve species), New Guinea (one species) and New Zealand (one species), whilst the second, which occurs in Australia, New Zealand, South America and, peculiarly, Mongolia, has fifteen endemic species in Australia out of a total of eighteen recorded for the continent. The less important calanoid genus, Hemiboeckella, is endemic to Australia.

Endemism occurs even in those groups which classically are regarded as consisting of cosmopolitan genera and species such as the Notostraca and copepods of the family Cyclopidae. Only a few examples need to be mentioned here. The single Australian species of the world wide notostracan genus Triops (T. australiensis (Spencer and Hall)) is endemic. Two endemic cyclopoids are Metacyclops arnaudi (Sars) and Microcyclops australis (Sars). Diacyclops crassicaudoides Kiefer is evidently restricted to Australia and New Zealand.

Turning now to the class Insecta, let us consider two orders not noted for their powers of flight, the Trichoptera and Plecoptera, and one which perhaps has rather better powers of dispersal, the Odonata.

Within the Trichoptera, two families are known only from Australia (Plectrotarsidae, Helicophidae), whilst another two are known only from Australia and New Zealand (Philanisidae, Philorheithridae). Two of these families are monogeneric (Philanisidae, Helicophidae), one has three genera (Plectrotarsidae) and the fourth has five genera, one endemic to New Zealand and four to Australia (Philorheithridae). With respect to families occurring both within and outside Notogaea, generic endemicity is high, being over two thirds of all genera recorded from Notogaea, and in a few families is complete

(Limnephilidae, Beraeidae, Molannidae). Considering only Australia, the total number of endemic genera is at least 43 and is likely to be much higher.

Two further points of interest may be mentioned in passing whilst dealing with the Trichoptera. First, the family Philanisidae contains the only known marine caddis fly (Philanisus plebeius Walker) according to Mosely and Kimmins (1953), and second, two genera of the Philorheithridae (Tasmanthrus, Austrheithrus) cut across the main division of the Trichoptera into the Aequipalpia and the Inaequipalpia.

The Australian Plecoptera are in many ways even more distinctive than the Trichoptera. All three subfamilies of the most primitive stonefly family, the Eustheniidae (suborder Archiperlaria), occur in Australia, one (Thaumatoperlinae) being endemic. Other eustheniid genera occur in New Zealand and South America. Several more advanced stonefly families are also to be found in Australia, of which one, the Austroperlidae, is endemic. However, all of these belong exclusively to the suborder Filipalpia, and there are no representatives of the remaining suborder, the Subulipalpia.

Lastly amongst the Insecta, we need consider briefly the Odonata. Writing upon this order, Tillyard (1926:73) noted that whilst the majority of Australian species are tropical or sub-tropical and are derived from the oriental fauna, there also exists a number of "archaic remnants, not found elsewhere, together with a very considerable autochthonous fauna, particularly rich in Gomphidae and Corduliidae". Of the "archaic remnants", the family Petaluridae is perhaps of most interest. This primitive, distinct and relict family was formerly widespread, being dominant in Jurassic times; now, it has dwindled until there are only nine extant species. Four of these, all belonging to the endemic genus Petalura, occur in Australia. The remaining genera occur in New Zealand (Uropetala), Chile (Phenes), eastern North America (Tachopteryx), and western North America and Japan (Tanypteryx). Mention must also be made of the family Hemiphlebiidae, containing the genus Hemiphlebia. Of this, Tillyard (1926) has remarked that it is probably the most primitive extant odonate. As before with other groups, we see that Australia seems to be the main area of survival for these archaic forms.

Finally, it remains to discuss the Bivalvia. This group, with one generic exception, forms a distinct faunal unit within the Australo-Papuan region, which fact, as pointed out by McMichael and Hiscock (1958) in their recent monograph on the group, had not been appreciated

prior to 1958. The family Hyriidae, which is confined to Australasia and South America, has given rise in Notogaea to four endemic subfamilies; the subfamily Velesunioninae (Velesunio, Alathyria, Microdontia and Westralunio) is confined to Australia and New Guinea: the Lortiellinae (Lortiella) occurs only in north-western Australia; the Hyridellinae (Hyridella) is found in Australia, New Zealand, and the Solomon Islands and New Guinea, each area having its own subgenus; and the subfamily Cucumerunioninae is found in Australia and New Zealand (Cucumerunio) and in New Guinea (Virgus). The only other family of freshwater mussels to occur in Notogaea is the Unionidae, but this, however, is represented by only a single endemic genus, Haasodonta, known only from New Guinea where two species occur. Haasodonta forms the exception noted above to the distinctiveness of the Australo-Papuan freshwater mussel fauna; the family also occurs in Europe, Asia, North America, northern South America, and in Africa.

Summarizing, we can say that there are certain invertebrate groups living in Australian inland waters which are primitive or phylogenetically relictual; a few of these parallel in zoological interest such vertebrates as kangaroos, echidnas, emus, koalas, platypuses and so on. Others are simply restricted to or at least find their major area of distribution within Australia. Yet others, although widely distributed throughout the world, have nevertheless developed in Australia endemic genera or species.

I wish to thank the following colleagues for criticism: Dr. I. A. E. Bayly, Mr. J. Bishop, Dr. I. D. Hiscock and Mr. A. Neboiss.

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Ecological Studies on the Entomostraca of some Lentic Environments of South-east Queensland with Special Reference to Boeckella minuta Sars (Copepoda: Calanoida)

by B. V. Timms
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Most of this work was carried out on the University Pond, St. Lucia, which is an artificial impoundment with a maximum depth of 6 feet and an area of 4.6 acres. The open water region was sampled at fortnightly intervals for a period of eight months beginning February, 1964, while the littoral weed beds were sampled for a period of eleven months beginning April, 1964. In both cases, sampling had to be terminated because the spread of the floating fern, Salvinia auriculata Aubl, made it impossible to row a dinghy on the pond. It is thought that the spread of S. auriculata, and the subsequent death and decay of the submerged macrophytes was an atypical event, probably associated with the drought.

Temperature, pH, and oxygen concentrations were measured on each sampling date, and the following ranges for these factors were obtained at the open water station:- temperature 14.0-26.5°C., pH 7.6-8.3 and oxygen 15-92% saturation. In the littoral areas, during periods of intense photosynthesis, pH values as high as 10.5 and oxygen concentrations of 129% saturation were recorded. On the other hand when the weed died and decayed pH values dropped to as low as 6.7, and oxygen concentrations to 13% saturation.

The order of dominance of the major inorganic ions was found to be $Na > Mg > Ca > K$, and $HCO_3 > Cl > SO_4$. Total dissolved solids ranged between 180 and 250 ppm. These orders of dominance are typical of Australian waters with this order of concentration.

In the limnetic region, the planktonic crustacea was dominated by Boeckella minuta Sars, particularly from April to August. Other crustacean species present included Eucyclops sp., Diaphanosoma excisum Sars and Chydorus spp. In September Potamogeton natans L. grew up in the limnetic region and associated with this there was a marked reduction in the numbers of Boeckella minuta, and an increase

in the numbers of typical littoral species.

In the B. minuta population, nauplii, immature copepodites and adults were found in all collections, indicating that this species is polycyclic. The fact that males outnumbered females in each collection is thought to be associated in some way with the eutrophic nature of the pond. The length of the adults and the number of eggs carried by the ovigerous females were found to vary seasonally and both were found to correlate inversely with temperature. Surprisingly enough, the female lengths did not correlate with the egg numbers. An unknown factor, possibly food, is thought to have influenced this correlation. In early May the female, but not the male, lengths were bimodal. From the little evidence that is available, it is possible that the bimodality may have resulted from two ecologically separated oversummering populations - one diapausing as eggs or CI-CV stages, and the other as active adults and juveniles. The metasomal lobes of the females were found to exhibit cyclomorphic variation. Thus, in his revision of the genus Boeckella, Ian Bayly's doubt concerning the value of these lobes as taxonomic characters is justified. Diurnal vertical migration was observed even though the pond was only 6 feet deep.

Hydrilla verticillata Presl. was the dominant macrophyte in the littoral weed beds. During July and August it died and slumped to the bottom, and, until November when it grew again, there was open water in lieu of weed beds. During this period, and when Salvinia auriculata covered the weed beds in February-March, the numbers of littoral Entomostracans were small compared to those during the periods when the weed beds were alive and densely packed. The dominant species in the littoral 'plankton' were Eucyclops sp., Macrothrix spinosa King and Chydorus spp., while Alona rectangula Sars, Simocephalus sp. and the harpacticoid Attheyella sp. were also present.

In a comparison of the populations of Boeckella minuta in seven reservoirs in south-east Queensland, it was shown that the length and egg number were greater in reservoirs with higher rates of water renewal. Also, from this series of measurements the lengths and egg numbers were found to be positively correlated. As is well known, limnetic zooplankton communities are composed of few species: the average for the above seven reservoirs plus five others was 2.3 copepod and 2.0 cladoceran species per reservoir. Typically the copepod population in a reservoir would be composed of a cyclopoid, a species of Boeckella, and often a species of Calamoecia. The cladoceran fauna would consist of Daphnia lumholtzi, Bosmina

meridionalis, and perhaps Ceriodaphnia sp.

ERRATUM

Physical Limnology of two North Queensland Crater Lakes (page 6, volume 4 (1)). The sentence "Situated at about 740 metre above sea level, the lakes are in an area of dry cool climate." should have read as follows:- "Situated at about 740 metre above sea level, the lakes are in an area of dry cool winter, warm wet summer, tropical mountain climate."

ANNOUNCEMENT

Dr. D. D. Francois, who represented the A.S.L. at a meeting of the steering committee to consider the following matter, has requested that the following announcement be made.

Australian Conference on Decapod Crustacea

The steering committee for the conference on decapod crustacea has decided that this meeting should be postponed until 1967, probably in the latter half of October. The committee was led to this conclusion by several considerations among which the representations with respect to timing made by some prospective participants carried much weight. Deferment means that more detailed work can go into the preparation of background documents whose availability will greatly assist the meeting. Deferment also seems likely to give better prospect of securing overseas participation; the committee has information indicating that there may be participation from South Africa, New Zealand and Canada. A further announcement will be issued at the earliest opportunity.

(G. L. Kesteven)
Convener
(on behalf of the Steering Committee)

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LETTERS

Bibliography of Arid Zone Publications

The following letter has been received from Dr. R. O. Slatyer, Arid Zone Research Liaison Officer, Division of Land Research and Region Survey, C.S.I.R.O., Canberra:

"The University of Arizona, Tucson, Arizona, in conjunction with the U.S. Army Office of Research and Development, is preparing an "Inventory of the Desert Environment", as part of which it is desired to collect an extensive bibliography of published and unpublished data on physical and biological aspects of arid and semi-arid environments.

Professor Lowe, from the Office of Arid Lands Research, has written to this Office asking if we could help with the collection of Australian material.

Could you help us by sending me a list of publications from your group, or yourself, extending back as far as you think appropriate, and enclosing reprints, if these are available. We will then send this information on to Professor Lowe who has told us that the results of the entire survey will be available to all contributors."

It is perhaps pertinent for the editor to point out that several A.S.L. members have recently received reprint requests from Professor G.A. Cole, Arizona State University, who is currently writing a chapter on Desert Limnology for a proposed Academic Press book on Desert Biology. This is a good example of the value of the A.S.L., and the usefulness of the Directory of Australian Limnologists to overseas workers.

NEWS AND VIEWS

Coming Visit by Noted Overseas Worker Professor J. Illies, a leading worker on the Plecoptera and stream ecology, will be visiting Australia towards the end of next year - the scheduled date of arrival in Canberra is September 6th, 1966. He will spend a month collecting in south-east Australia, paying particular attention to the Mt. Kosciusko region and Tasmania. A fortnight has also been set aside for collecting in Western Australia. In addition Prof. Illies will spend a month in New Zealand where he will join forces with a party from the Canterbury Museum to visit Fjordland. Wingless Plecoptera with Antarctic affinities have been reported from this region. Finally he will visit New Guinea for a fortnight to collect from mountainous regions whilst staying at the Bishop Museum field station. Professor Illies would no doubt be delighted to examine any plectopteran collections that A. S. L. members may have.

EDITORIAL REMINDER

Had more contributions been received from A. S. L. members this page and the next would have been full. What is more, you would not have had to put up with such a dominance of Monash invertebrate-type contributions! (Being aware of this bias, I have used the word "trout" at least twice in the Editorial).

STOP PRESS

By means of threat display I managed to obtain the following contribution at a minute's notice. Unfortunately it does nothing to correct the above bias. The remedy is in your own hands!

The Great Stenocypris Muddle: a Cautionary Tale for Taxonomists

by K. G. McKenzie,
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Monash University

The affair began quietly, in a geological paper by J. Malcomson, with a brief note on a fossil ostracode species, Cypris cylindrica (described by J. deC. Sowerby), which he had collected in the Sichen Hills, India. In 1859, William Baird amplified this description and provided a figure of what he considered to be C. cylindrica based on

Recent material from Nagpur, India. Almost a generation passed before the matter was reviewed again, this time by George Stewardson Brady, F.R.S., who decided that the Recent and fossil species were different and named the Recent form, Cypris malcomsoni, basing it on Ceylonese material which he had compared against Baird's specimens and the fossils collected by Malcomson.

Three years later, in 1889, G.O. Sars, the father of ostracode taxonomy, erected a new genus, Stenocypris, based on an Australian form which he equated with Brady's species, thus making (by monotypy) malcomsoni the type species of his new genus. Subsequently, several species of Stenocypris were described by Sars and other workers.

In 1953, Erich Triebel, working at the Senckenberg Museum, concluded that malcomsoni Brady was a junior synonym of major Baird, a new variety Baird had proposed in the 1859 paper. It appears to be established, therefore, that the type species of Stenocypris is an Asian form whether it is called major or malcomsoni.

Recently, Ian Bayly showed me numerous specimens of a Victorian ostracode which seems to be identical with the form Sars described in 1889 (from Gracemere and Crescent Lagoons). This judgement is based on a comparison limb for limb and with respect to carapace features between the Victorian form and Sars' somewhat generalised illustration - Sars' types appear to be lost. Even if the two forms are different, however, neither is the same species as Stenocypris malcolmsoni, as I have ascertained by direct comparison with the Brady types from Ceylon which are on loan to me from Hancock Museum, Newcastle-upon-Tyne! Fortunately, Sars' species is a Stenocypris sensu stricto which is just as well because the original genus is now split three ways, viz., Stenocypris Sars, Chrissia Hartmann 1957 and Parastenocypris Hartmann 1964, and has even been made the type genus of a new subfamily, Stenocyprinae, by Ferguson, 1964.

The confusion that has arisen could have been avoided quite simply if Sars had given his species a new name and made that the type instead of referring it to one already esconced in the literature without consulting the type material. The moral for taxonomists is: before you erect a new genus know your type species lest some future worker is compelled to cite 5 papers and reexamine the original material before he understands what you were trying to say!